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January 12, 2004

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RELATED PCT APPLICATION NUMBER: *PCT/US03/34318*

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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60/422571
JC973 U.S. PTO

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☑ *Additional inventors are being named on the* 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

HIGH STRENGTH DIMENSIONALLY STABLE CORE

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages*	8	☐ CD(s), Number	
☑ Drawing(s) *Number of Sheets*	10	☑ Other (specify)	Assignment; Power of Attorney
☐ Application Data Sheet. See 37 CFR 1.76			

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.
☑ A check or money order is enclosed to cover the filing fees
☑ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 07-2069
☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): $160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.
☑ No.
☐ Yes, the name of the U.S. Government agency and the Government contract number are: ____________________

Respectfully submitted,

SIGNATURE Paul G. Juettner

Date 10/31/2002

TYPED or PRINTED NAME Paul G. Juettner

REGISTRATION NO. *(if appropriate)* 30,270

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Docket Number: 0329.66419

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

PROVISIONAL APPLICATION COVER SHEET
Additional Page

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Docket Number	0329.66419

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Number 2 of 2

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HIGH STRENGTH DIMENSIONALLY STABLE CORE

Field of the Invention

This invention relates to paperboard cores and tubes, and to paperboard for making cores and tubes.

Background of the Invention

In the manufacture of paper, paper is wound onto cores. Cores are conventionally manufactured from laminated, spirally wound paperboard. It is important that cores have sufficient crush strength. Dimensional stability of cores is also important in roll handing operations.

Moisture content in paper varies considerably from grade to grade depending on the manufacturing process. Similarly, paperboard cores are made at different moisture levels, depending on the absorption characteristics of the paperboard from which it is made and the adhesive used to glue the board layers to form a laminated core. As a result, in the winding of paper onto cores, there is typically a moisture content difference between the paper and the core. A difference is moisture content between the paper and core causes moisture to migrate. Moisture migration from the core to the paper and vice versa can cause corrugations and wrinkling in the paper, and in some cases core bursts, resulting in paper losses.

Papermills today make wide paper rolls by winding different webs of paper onto a single core. Often, the different webs have different moisture contents, aggravating moisture migration problems. Further, these wide rolls require high strength cores to support the substantial weight of the paper.

Summary of the Invention

It is an object of the invention to provide a high strength, dimensional stable core, with improved resistance to moisture migration. It is a further object of the invention to provide a high strength, water resistant paperboard that has utility in the fabrication of such cores.

The core of the invention is manufactured from spirally wound paperboard having improved water resistance. The paperboard is made from furnish comprising a mixture of 25-70% doubleliner kraft ("DLK"), and 25-70% recycled corrugated containers ("OCC"), and 30-50% recycled cores and/or other cores waste ("corebale"). The furnish should have a freeness of 150-275 CSF. The furnish is modified by adding 1-60 lbs/ton alum, and 3-40 lbs/ton of liquid size. Preferably, 0.2 - 1. lbs/ton microparticle silica, and 16-50 lbs/ton modified cationic starch, and/or 2-8 lbs/ton of a dry strength agent may also be added, but are not required.

It has been discovered that the combination of alum and a liquid size substantially improves water resistance. A suitable alum product is aluminum

sulfate solution available from General Alum & Chemical Corporation, Holland, Ohio.

A preferred liquid size is Ultra-pHase® cationic dispersed size manufactured by Hercules Incorporated, Wilmington, Delaware.

The microparticle silica is added to improve the drainage in the paperboard making process. A preferred microparticle silica is Nalco 8692 Papermaking Aid, an aqueous dispersion of an inorganic hydrous oxide microparticle, manufactured by Nalco Chemical Company, Naperville, Illinois. Other microparticle silica products may be used as well.

The modified cationic starch improves strength. A preferred starch product is Penford Topcat 776 cationic additive, manufactured by Penford Products Co., Cedar Rapids, Iowa. Other suitable starch products are Avebèe Amylofax 3300C and Amylofax-HS.

The dry strength agent improves strength and contributes somewhat to improvement in water resistance. Suitable dry strength agent is Callaway 911 dry strength agent, manufactured by Vulcan Performance Chemicals, Birmingham, Alabama.

The forgoing optional additives are selected and added to as required to produce the required properties of the core. For example, if a high strength is not required, one could use little or no starch or dry strength agents. Other additives could be used, for example a wet strength agent.

The modified furnish is manufactured into paperboard by known manufacturing techniques, such as fourdrinier or multiple cylinder papermachine, to produce a finished paperboard having a basis weight of 40-142 lbs per 1000 sq/ft., a caliper of about 0.013 to .041 inches, a density of 0.7 to 1.0 g/cm^3 and a moisture content of between about 3-6 percent. The moisture content of the cores preferably should be as close as possible to the moisture content of the paper to be wound onto the cores.

The paperboard is then wound with conventional core machinery to form paperboard cores having between 3-32 plies. For example, one embodiment of the invention comprises high strength cores for paper rolls, which have 20-32 plies. Another application of the invention is for cores for adhesive tape and other small tube applications, which have 3-7 plies. In smaller cores made in accordance with this disclosure have a lower core crush variability due to humidity and improved dimensional stability. The preferred adhesive used in winding the cores is polymer base, such as latex; however, other adhesives may be used.

Testing on the cores made in accordance with the foregoing exhibited increased crush strength, and increased water holdout. The cores exhibited reduced moisture carry over, and low core length shrinkage. Other benefits include reduced core warpage and less variability in core inner and outer diameter.

Detailed Description of Preferred Embodiments

Examples of the improved high strength, dimensional stable cores of the invention are provided as follows:

GP1 Standard

The furnish comprised: 95 lbs DLK, 1,000 lbs OCC and 1,400 lbs corebale. Paperboard was manufactured from the furnish on a conventional board machine. The resulting paperboard had a caliper of about 0.02 inches and a basis weight of about 80 lbs/1,000 square feet. The core was wound in conventional process, having a lead-in ply and 30 structural plies formed with the above furnish. The cores had an internal diameter of 3.025 inches and a wall thickness of 0.66 inches.

Paperboard and cores were tested for water absorption and strength. The paperboard had a water absorption of less than about 950 - 1150 cgs based on the amount of water absorbed by a 6" x 6" paper board sample submerged in a water bath for 10 minutes. The paperboard had a ZDT bond strength of 100 "Z"directional internal bond strength of board tested on a ZDT tester. Core crush strength was 800-850 lbs on a 4" length of core, and Dynamic load strength of 26-29 lbs/4" section. The moisture content of the core was 9-11%.

Example P1

The same paperboard and cores as in Example GP1 were manufactured, except that the following constituents were added to the furnish:

Callaway 911dry strength agent @ 6 lbs/ton dry weight

Ultra-Phase liquid size @ 31 lbs/ton dry weight

Alum was varied between 30 and 60 lbs/ton dry weight

Paperboard and cores were tested for water absorption and strength. The paperboard had a water absorption of less than 400 cgs based on the amount of water absorbed by a 6" x 6" paper board sample submerged in a water bath for 10 minutes. The paperboard had a ZDT bond strength 105 - "Z"directional internal bond strength of board tested on a ZDT tester. Core crush strength was 1135 lbs on a 4" length of core, and Dynamic load strength of 35.2 lbs/4" section. The moisture content of the core was 7.86%.

Example P2

The same paperboard and cores as in Example GP1 were manufactured, except that the following constituents were added to the furnish:

Callaway 911dry strength agent @ 6 lbs/ton dry weight

Ultra-Phase size @ 16 lbs/ton dry weight

Avebe Amylofax-HS starch was varied between 33 and 50 lbs/ton dry weight

Alum was varied between 30 and 60 lbs/ton dry weight

Paperboard and cores were tested for water absorption and strength. The paperboard had a water absorption of less than 400 cgs based on the amount of water absorbed by a 6" x 6" paper board sample submerged in a water bath for 10 minutes. The paperboard had a ZDT bond strength 112-150 - "Z"directional internal bond strength of board tested on a ZDT tester. Core crush strength was 1238 lbs on a 4" length of core, and Dynamic load strength of 36.3 lbs/4" section. The moisture content of the core was 8.43%.

Example P5

The same paperboard and cores as in Example GP1 were manufactured, except that the following constituents were added to the furnish:

Penford Topcat 776 cationic starch @ 30 lbs/ton dry weight

Ultra-pHase size @ 3 lbs/ton dry weight

Alum @ 4 lbs/ton dry weight.

Paperboard and cores was tested for water absorption and strength. The paperboard had a water absorption of less than 700 cgs based on the amount of water absorbed by a 6" x 6" paper board sample submerged in a water bath for 10 minutes. The paperboard had a ZDT bond strength 125-141 - "Z"directional

internal bond strength of board tested on a ZDT tester. Core crush strength was 1299 lbs on a 4" length of core, and Dynamic load strength of 36.5 lbs/4" section. The moisture content of the core was 7.23%.

Attached as Figures 1-10 are graphs that summarize comparative testing on the cores of the foregoing examples.

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Figure-1: Custom Made Cores
Effect of Ambient Drying On Core Moisture

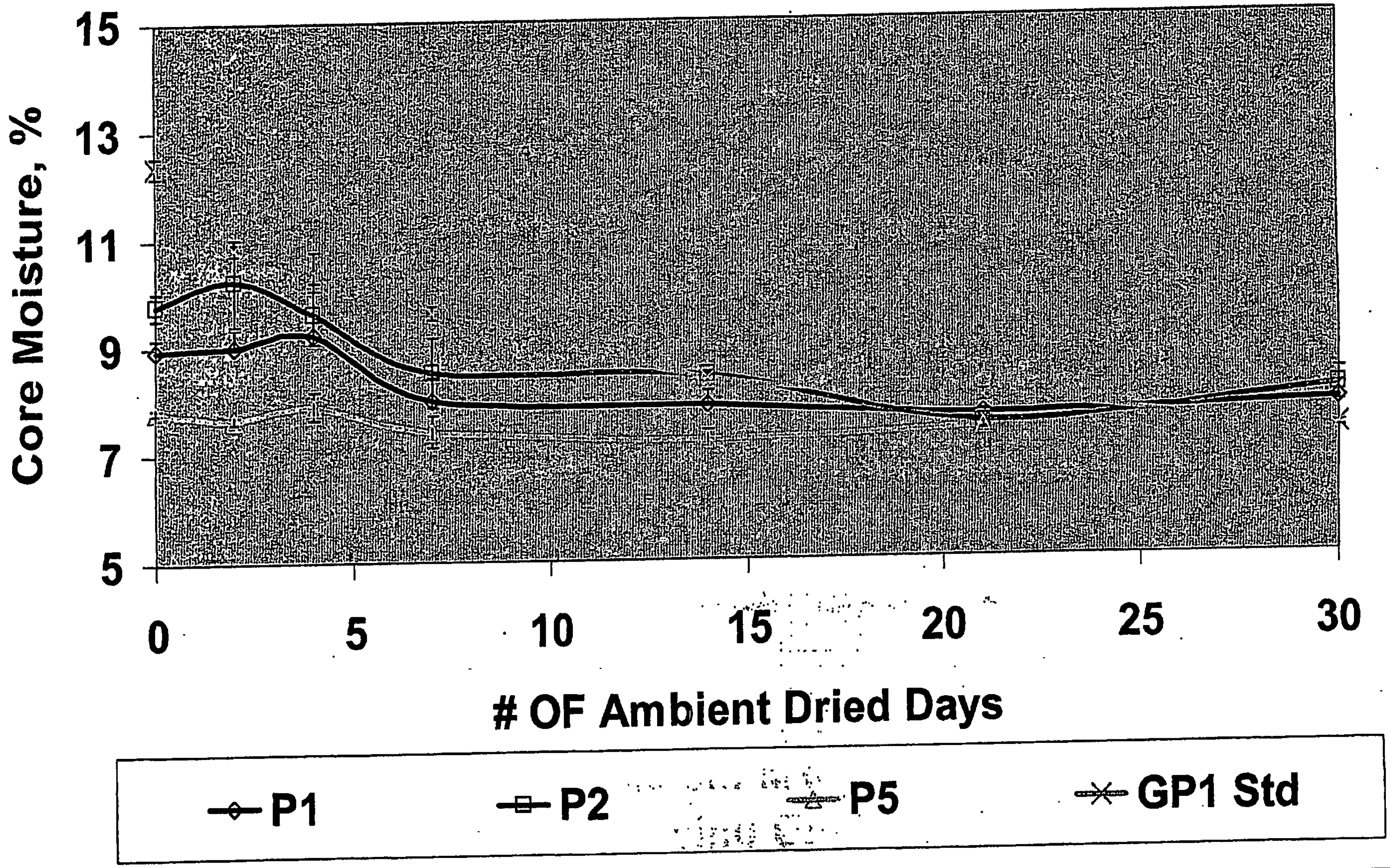

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Figure-2: Custom Made Cores
Effect of Ambient Drying On Core Crush

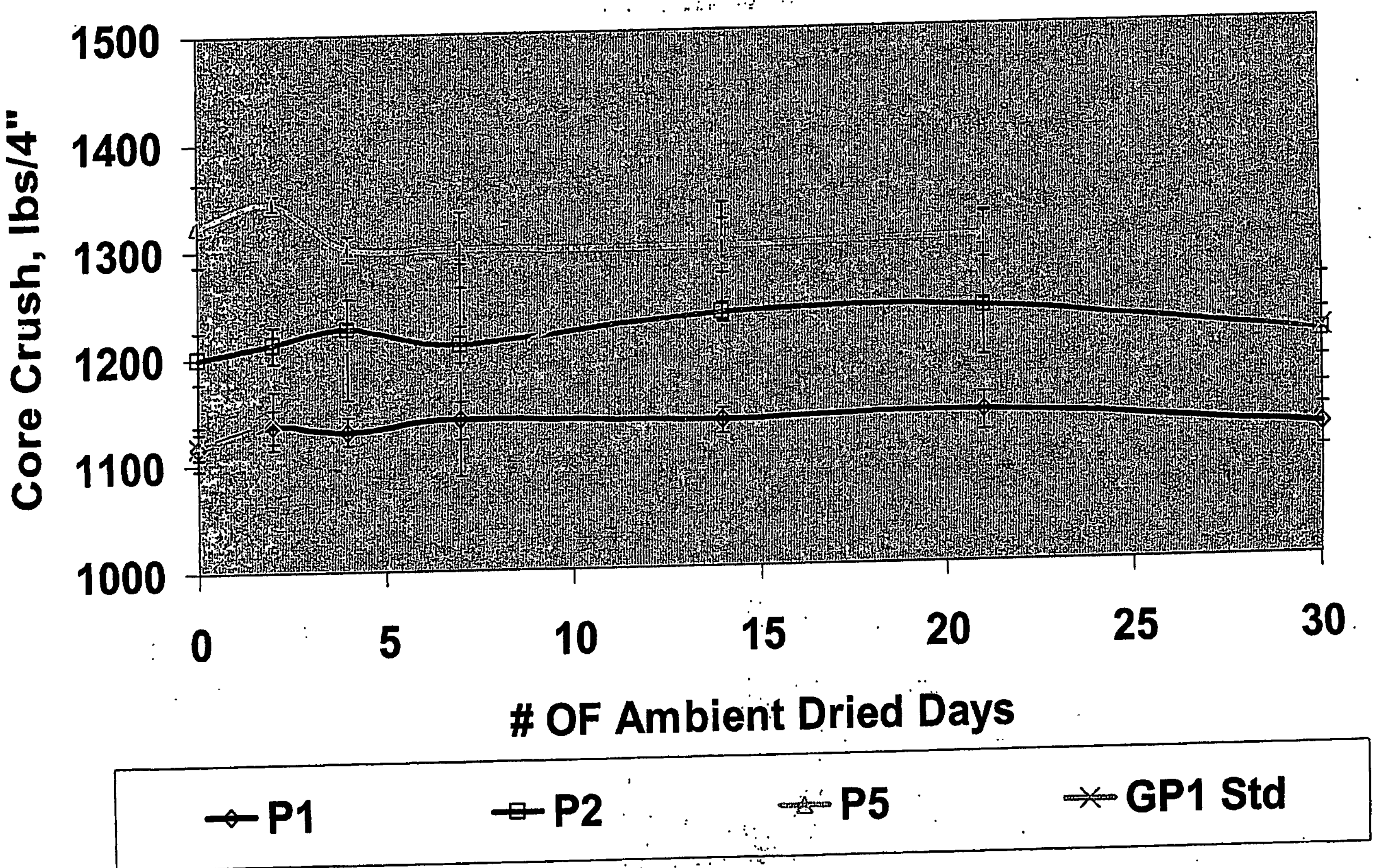

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Figure-3: Custom Made Cores
Effect of Ambient Drying On Torsional Strength

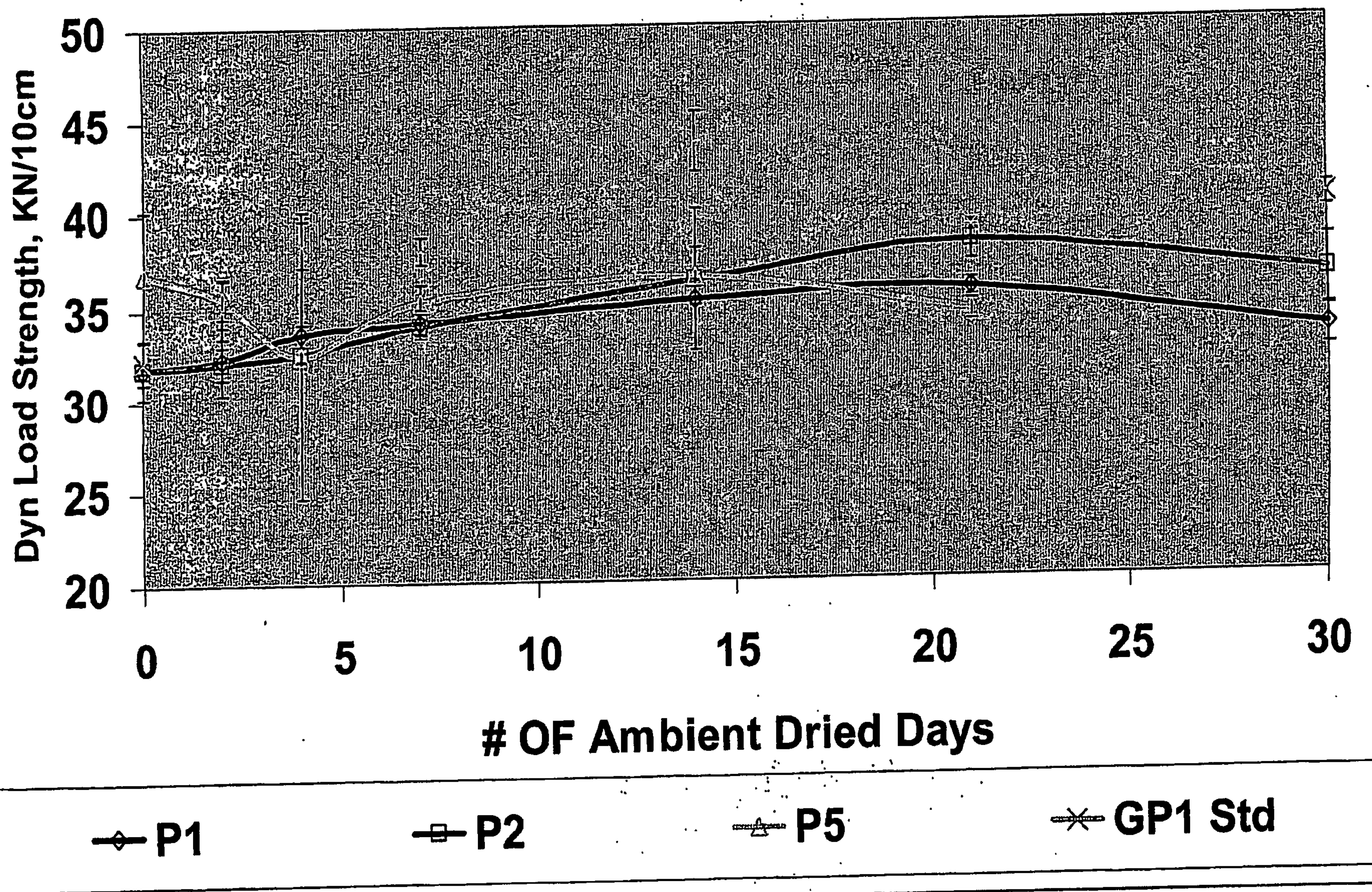

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Figure-4: Custom Made Cores
Effect of Ambient Drying On Length Shrinkage

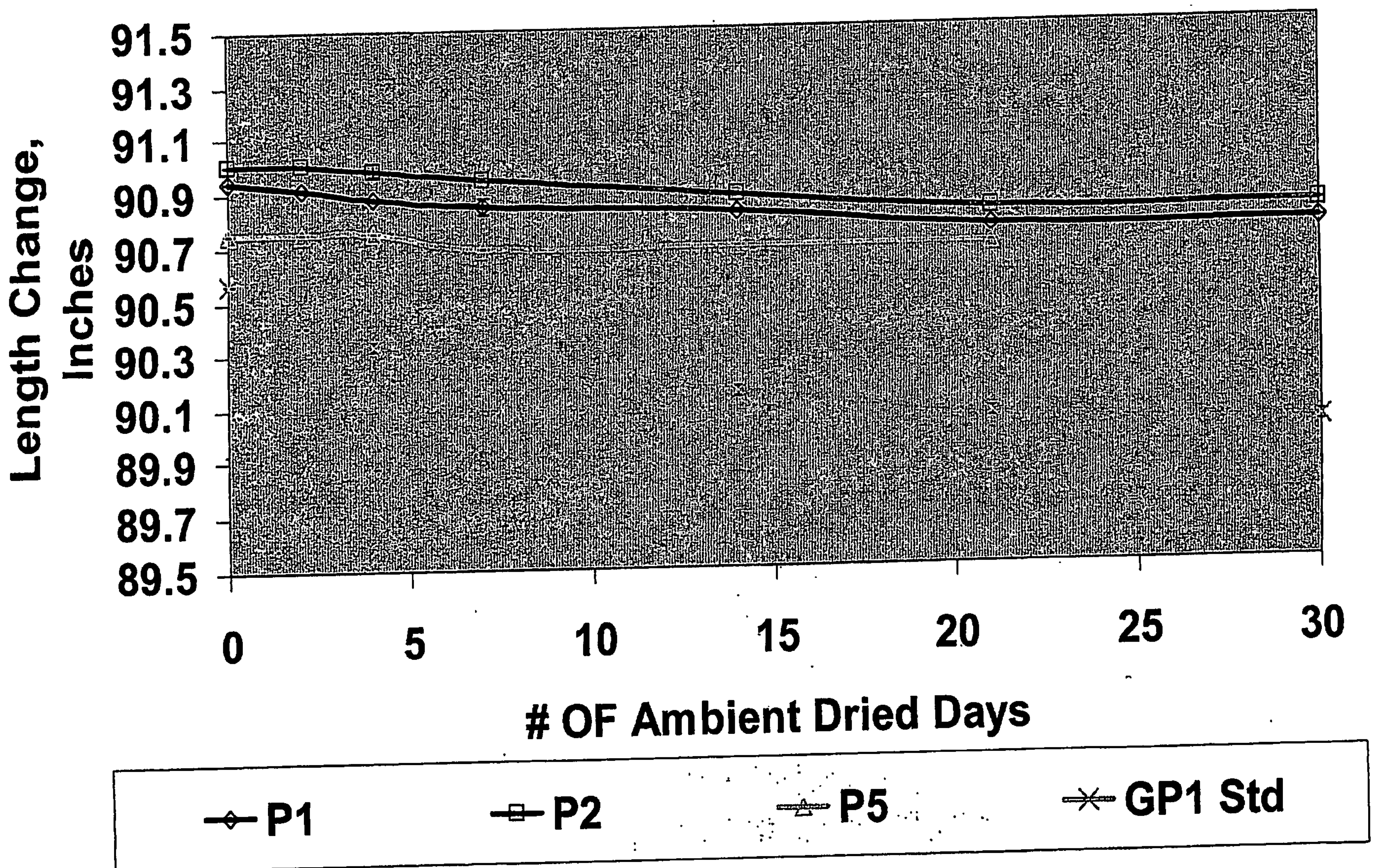

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Figure-5: Custom Made Cores
Effect of Ambient Drying On Core Warp

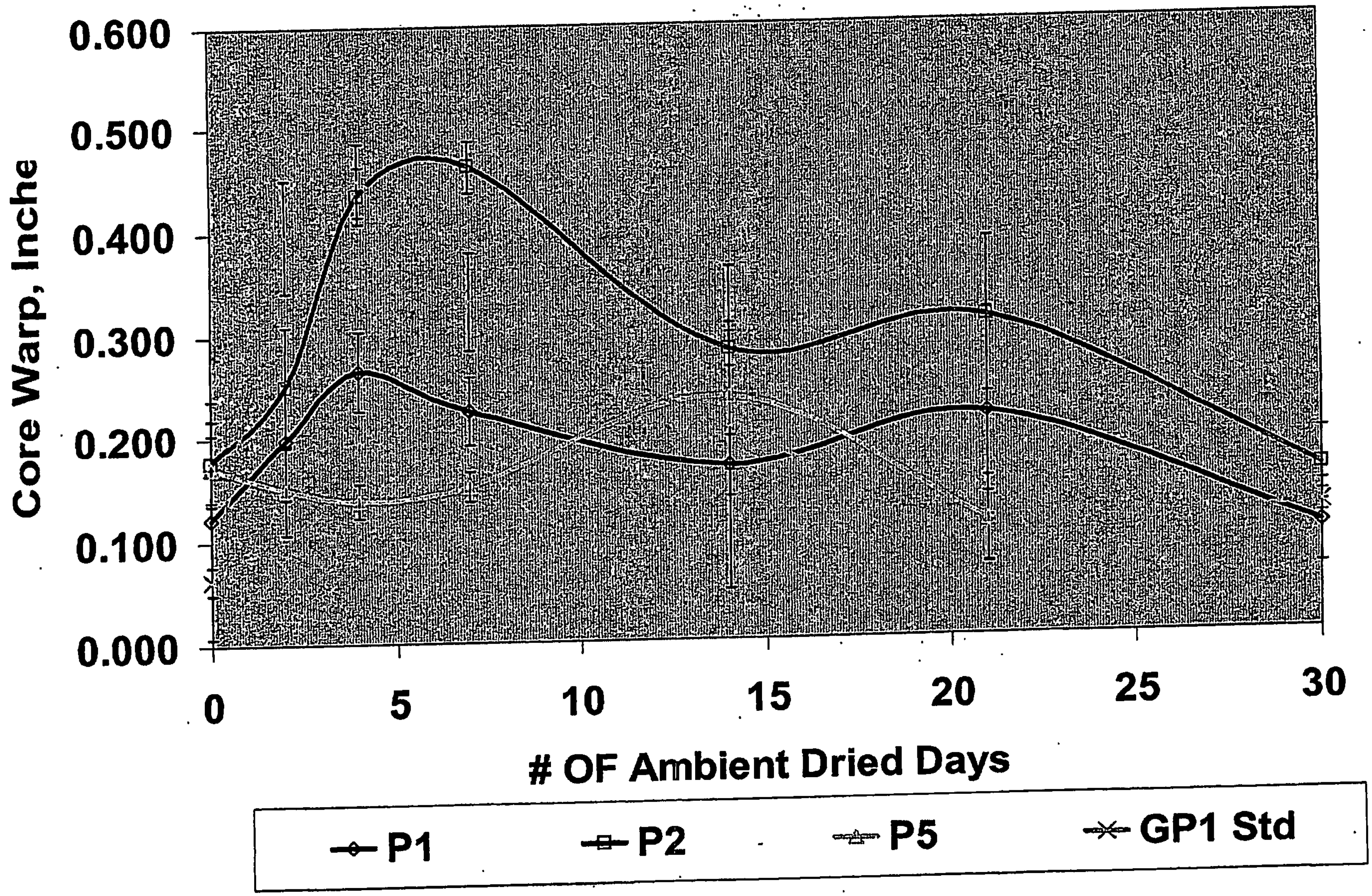

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Figure-6: Custom Made Cores
Effect of Ambient Drying On Core Outer Diameter

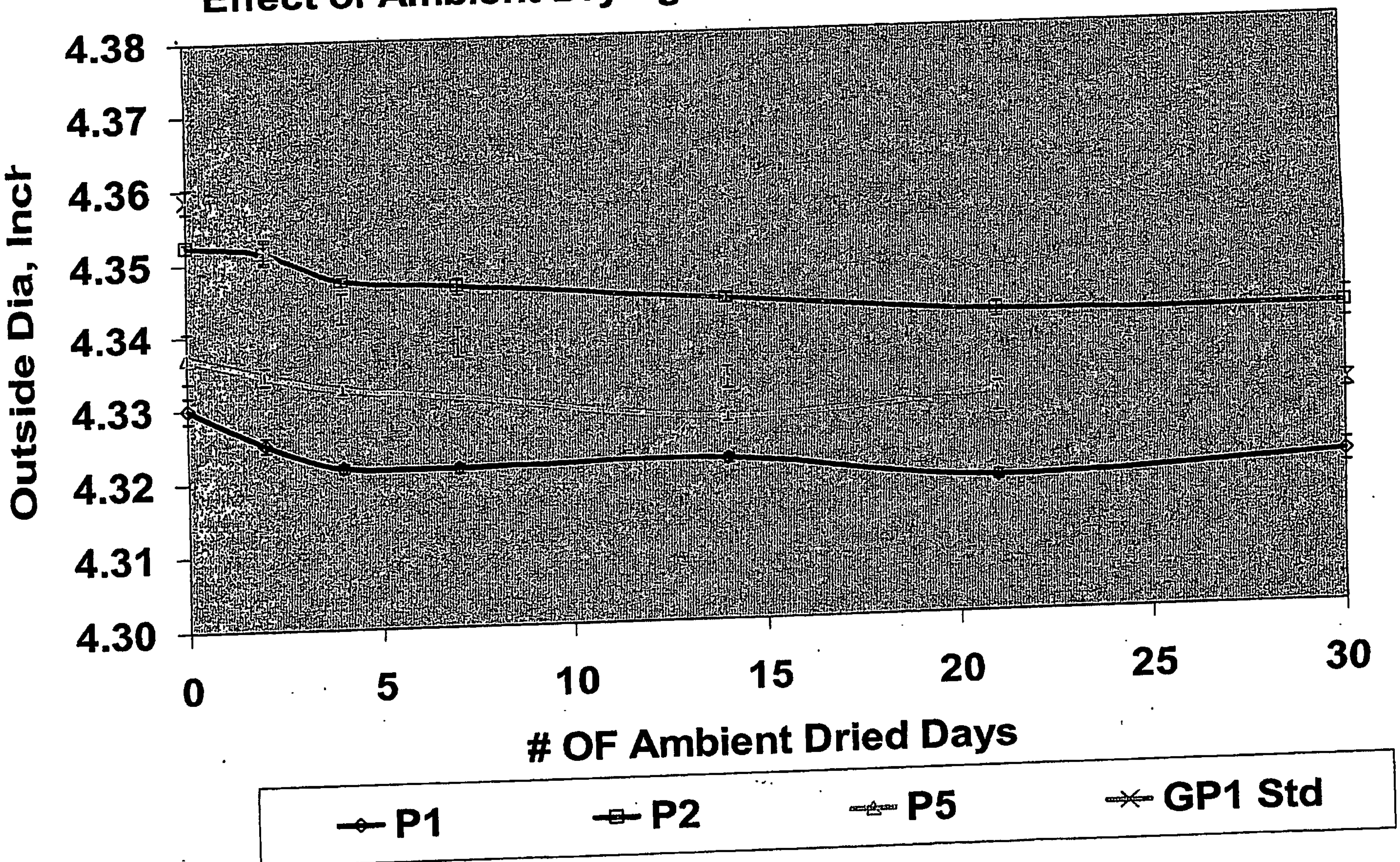

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Figure-7: Custom Made Cores
Effect of Ambient Drying On Core Inner Diameter

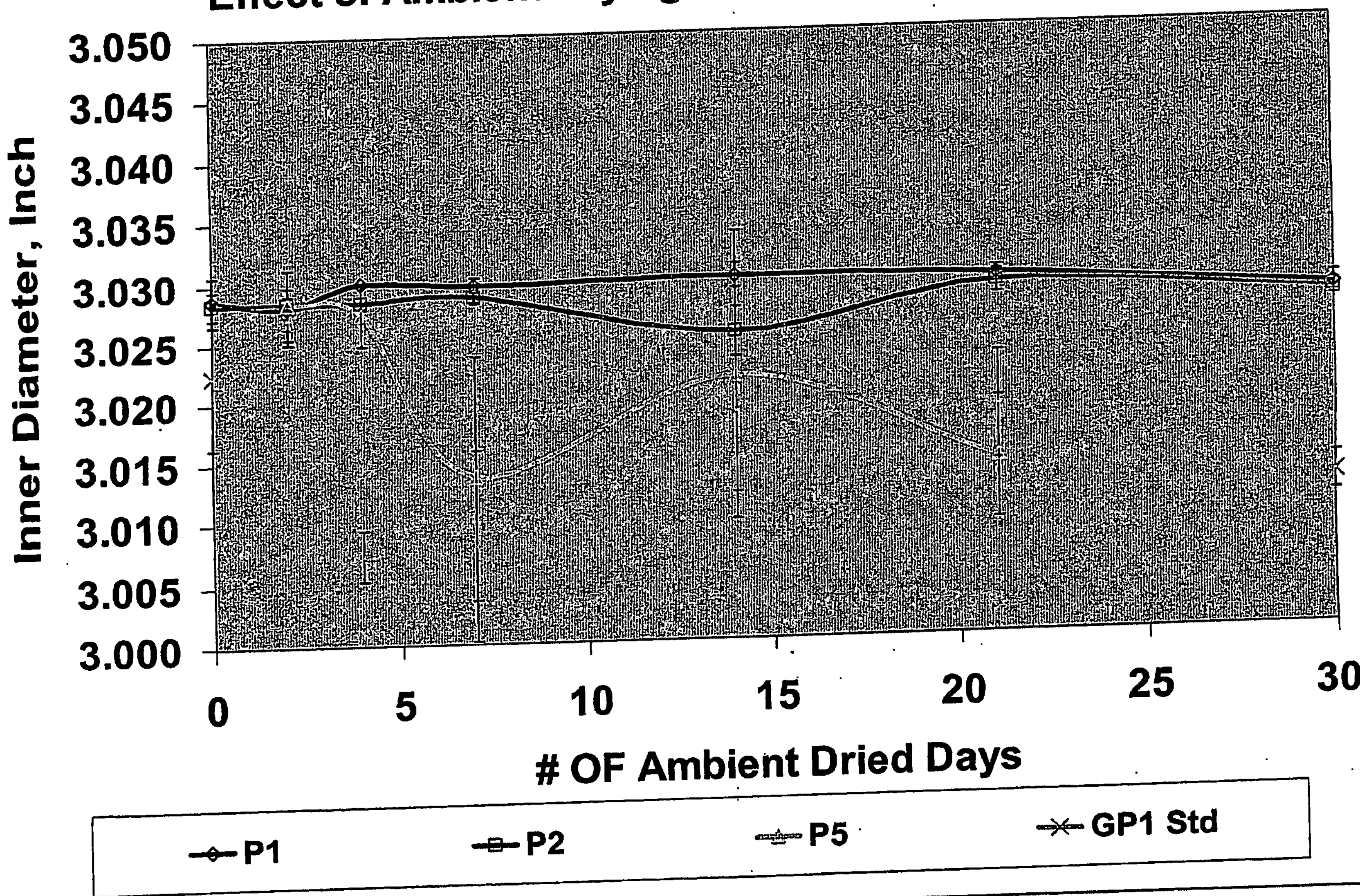

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Figure-8: Custom Cores
Effect of Oven Drying @120 Deg F For 16 Hours on Core Moisture

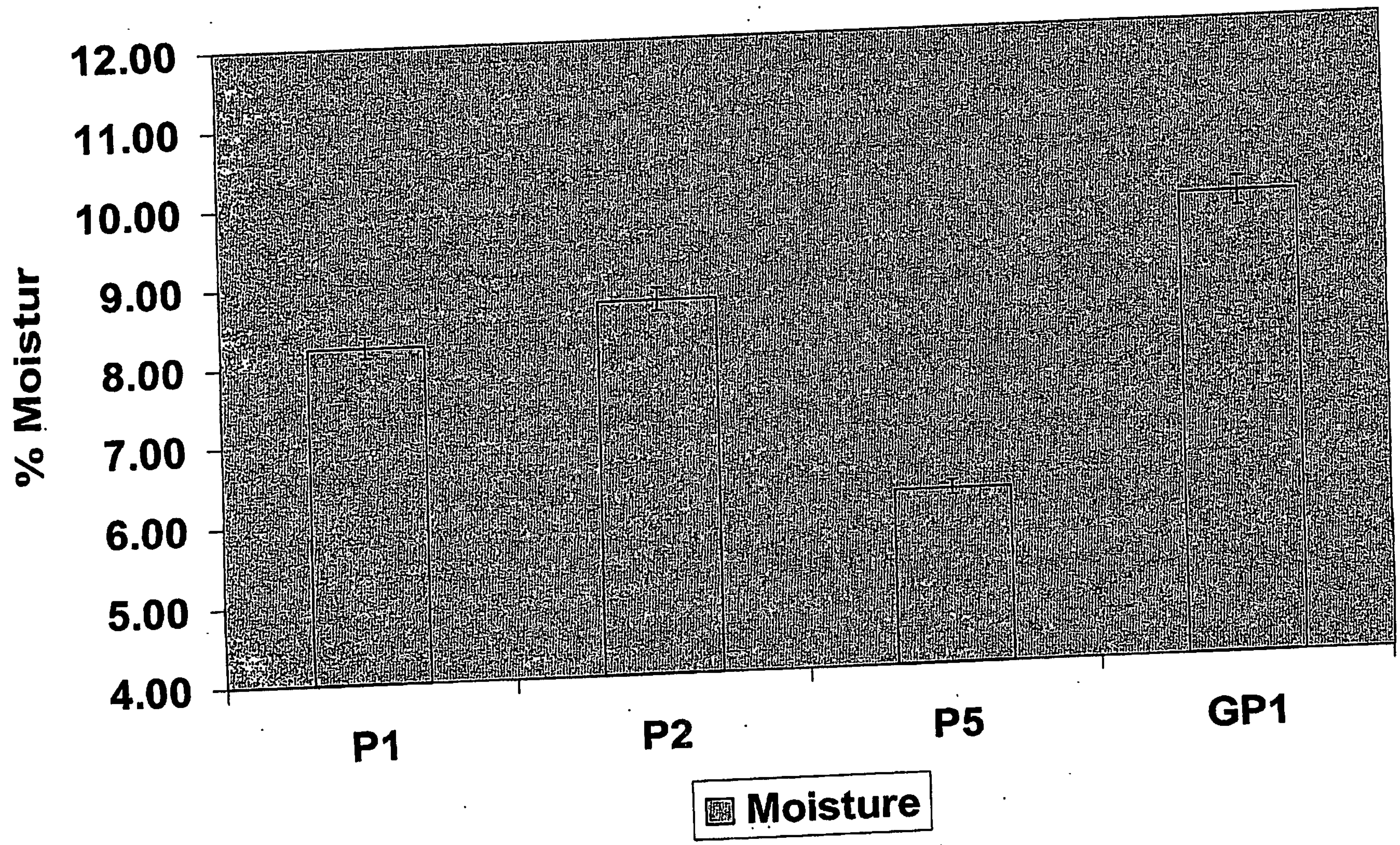

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Figure-9: Custom Cores
Effect of Oven Drying @ 120 deg F for 16 hours on Core Crush

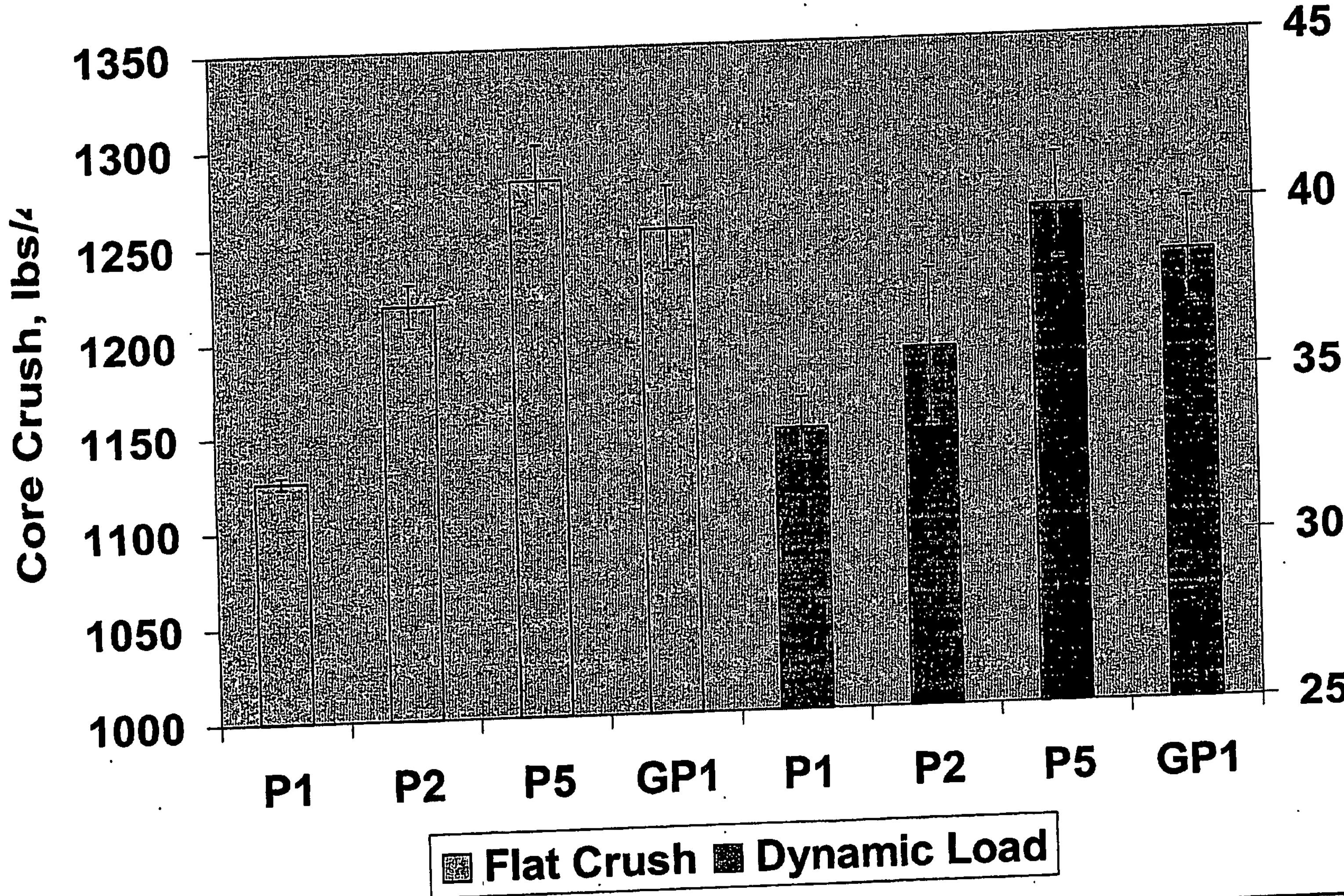

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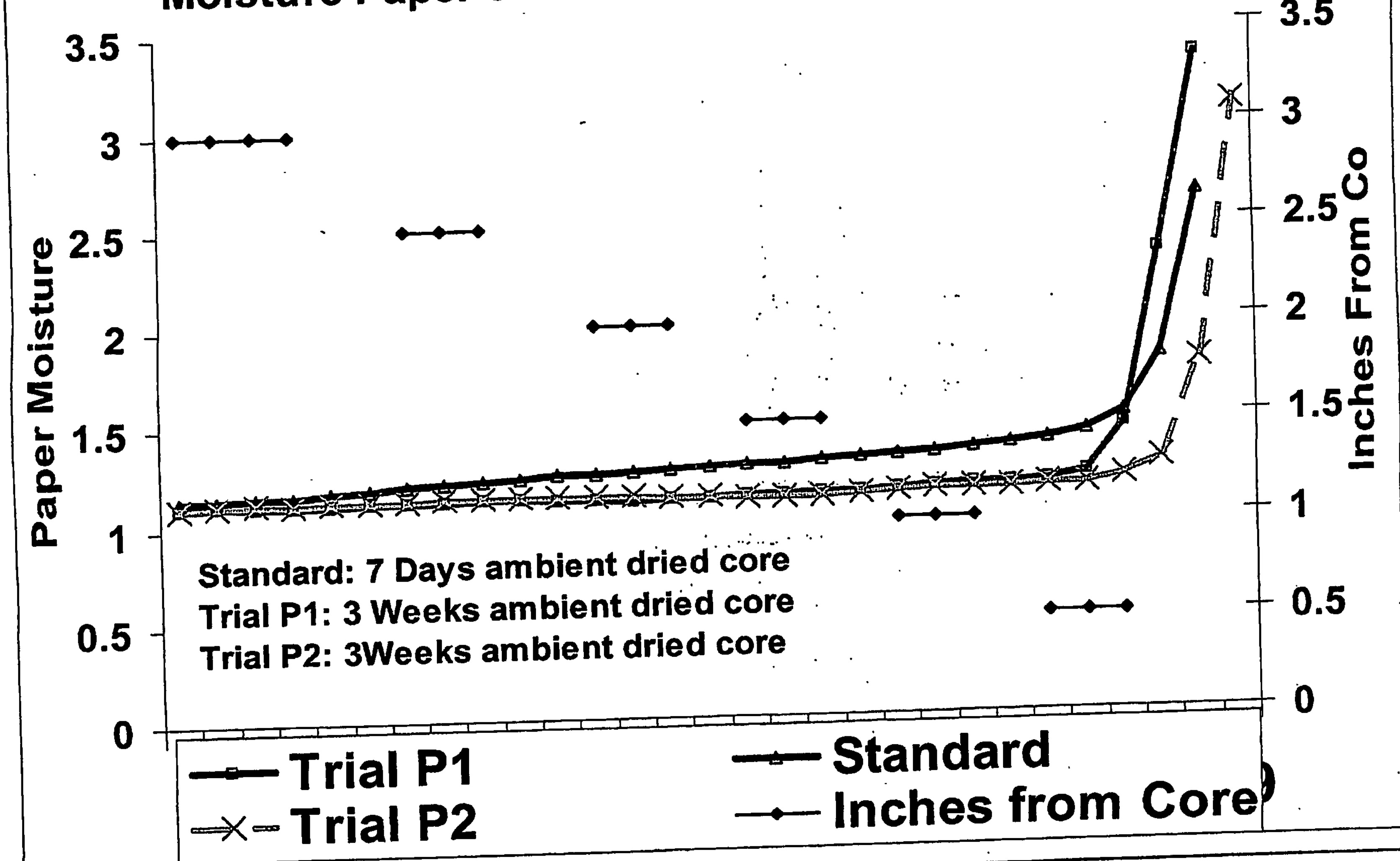
Figure-10: Moisture Migration Study Winding 1.5% Moisture Paper on Ambient Dried Cores-B:Research



Practitioner's Docket No. 0329.66419 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Gopal Iyengar, Jeffrey G. Dicks, Mark D. Ellis and Gary G. Glodos

☐ Application No.: / ☒ Filed herewith

For: HIGH STRENGTH DIMENSIONALLY STABLE CORE

POWER OF ATTORNEY FOR PROVISIONAL APPLICATION

Each inventor, identified above and signing below, hereby appoints the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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Date: 7/18/02	MARK D. ELLIS	Mark D. Ellis
Date: 7/18/02	Jeffrey G. Dicks	Jeffrey G. Dicks